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## 6.2 Ecosystem Monitoring (Plants and Wildlife)

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The Hanford Site is a relatively large, undisturbed area of shrub-steppe that contains a rich, natural diversity of plant and animal species adapted to the region's semiarid environment. Terrestrial vegetation on the site consists of ten major plant communities: 1) sagebrush/bluebunch wheatgrass, 2) sagebrush/cheatgrass or sagebrush/Sandberg's bluegrass, 3) sagebrush-bitterbrush/cheatgrass, 4) grease wood/cheatgrass-saltgrass, 5) winterfat/Sandberg's bluegrass, 6) thyme buckwheat/Sandberg's bluegrass, 7) cheatgrass-tumble mustard, 8) willow or riparian, 9) spiny hopsage, and 10) sand dunes (Neitzel 1996). Nearly 600 species of plants have been identified on the Hanford Site (Sackschewsky et al. 1992). Recent work by The Nature Conservancy has further delineated 36 distinct plant community types (Soll and Soper 1996) from within those 10 major communities.

There are two types of natural aquatic habitats on the Hanford Site: one is the Columbia River and the other is provided by the small spring streams and seeps located mainly on the Fitzner/Eberhardt Arid Lands Ecology Reserve on Rattlesnake Mountain. These include Rattlesnake Springs, Dry Creek, Snively Springs, and West Lake, a small, natural pond near the 200 Areas.

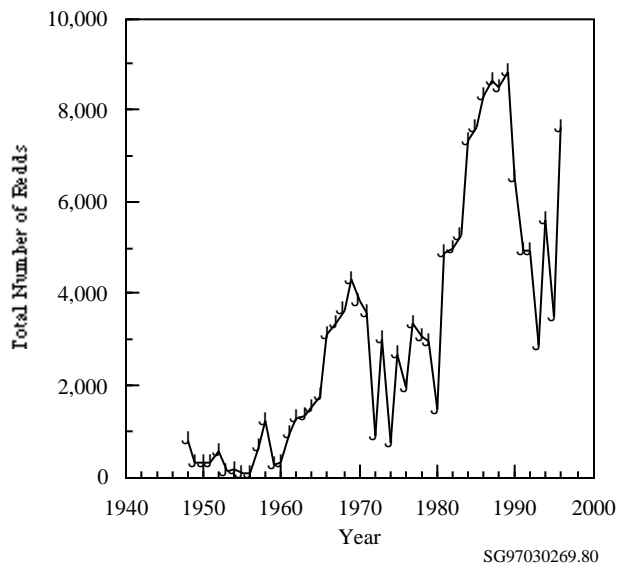
More than 1,000 species of insects (Soll and Soper 1996), 12 species of reptiles and amphibians (Neitzel 1996), 44 species of fish (Gray and Dauble 1977, Neitzel 1996), 214 species of birds (Soll and Soper 1996), and 39 species of mammals (Neitzel 1996) have been found on the Hanford Site. Deer and elk are the major large mammals, coyotes are plentiful, and the Great Basin pocket mouse is the most abundant mammal. Waterfowl are numerous on the Columbia River, and the bald eagle is a regular winter visitor along the river. Salmon and steelhead are the fish species of most interest to sport fishermen and are commonly used by local Native American tribal members.

Although no Hanford Site plant species have been identified from the federal list of threatened and endangered

species (50 CFR 17.12), recent biodiversity inventory work conducted by The Nature Conservancy has identified 82 populations of 17 rare plant taxa. In addition, The Nature Conservancy described 53 occurrences of 9 priority plant communities (Soll and Soper 1996). The U.S. Fish and Wildlife Service lists the peregrine falcon as endangered and the bald eagle and Aleutian Canada goose as threatened (50 CFR 17.11). The peregrine falcon and Aleutian Canada goose are migrants through the Hanford Site, and the bald eagle is a common winter resident and has initiated nesting on the Hanford Site but never nested successfully. Several plant species, mammals, birds, molluscs, reptiles, and invertebrates occurring on the Hanford Site currently are candidates for formal listing under the Endangered Species Act. Appendix F lists special-status species that could occur on the Hanford Site.

### Chinook Salmon

Chinook salmon are an important resource in the Pacific Northwest. Salmon are caught commercially and for recreation. The commercial and recreational catch is managed carefully to sustain the resource. Today, the most important natural spawning area in the mainstem Columbia River for the fall Chinook salmon is found in the free-flowing Hanford Reach. In the early years of the Hanford Site, there were few spawning nests (redds) in the Hanford Reach (Figure 6.2.1). Between 1943 and 1971, a number of dams were constructed on the Columbia River. The reservoirs created behind the dams eliminated most mainstem spawning areas and increased salmon spawning in the Hanford Reach. Fisheries management strategies aimed at maintaining spawning populations in the mainstem Columbia River also have contributed to the observed increases. The number of fall Chinook salmon redds counted in the Hanford Reach increased through the decades of the 1960s, 1970s, and 1980s until reaching a high in 1989 of nearly 9,000 (see Figure 6.2.1).

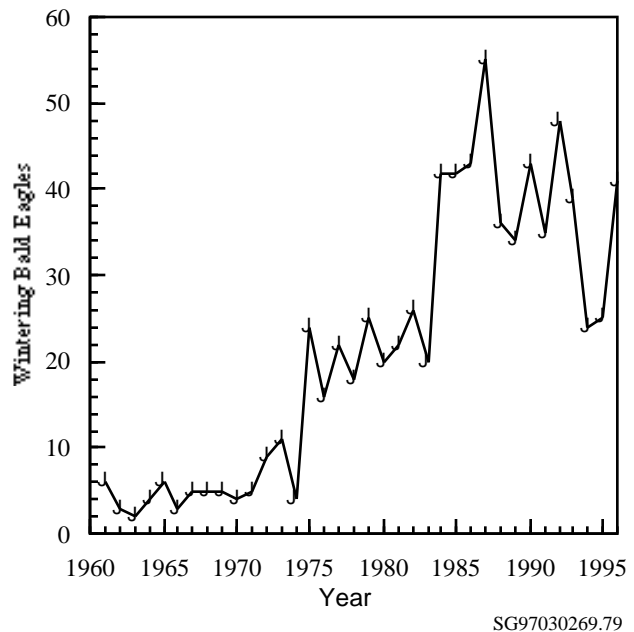


**Figure 6.2.1.** Chinook Salmon Spawning Redds in the Hanford Reach, 1948 Through 1996

In the early 1990s, redd counts declined to approximately one-third the 1989 peak, but they appear to have rebounded in recent years. In 1996, approximately 7,600 redds were observed. It should be noted that aerial surveys do not yield absolute counts of redds because visibility varies, depending on water depth and other factors, and because the number of redds in high-density locations cannot be accurately counted. We have noted, however, that redd survey data generally track adult escapement figures obtained by counting migrating adult fish at fish ladders on the Columbia River.

## Bald Eagle

The bald eagle is listed as a federally threatened species (50 CFR 17.11) and also a Washington State threatened species (Washington State Department of Wildlife 1994). Historically, bald eagles have wintered along the Hanford Reach of the Columbia River. However, when monitoring began in the early 1960s, numbers were low (Figure 6.2.2). Following the passage of the Endangered Species Act in 1973, the number of wintering bald eagles increased. Possible reasons for the observed increase are the added protection of bald eagles at nesting locations off the Hanford Site and the nationwide elimination of dichlorodiphenyltrichloroethane (DDT) as an agricultural pesticide in 1972. A total of 41 wintering bald eagles



**Figure 6.2.2.** Bald Eagles Observed Along the Hanford Reach, Fall and Winter Months, 1961 Through 1996

were counted on the Hanford Reach in 1996, which is up from 25 observed in 1995. Changes in the number of eagles on the Hanford Site generally correspond to changes in the number of returning fall Chinook salmon, a major fall and winter food source for eagles (compare Figures 6.2.1 and 6.2.2 to see similarity in the patterns of salmon redd counts and bald eagle counts). Thus, it appears that the number of bald eagles occupying the Hanford Reach in any given year may be directly related to the local abundance of food.

Protection for bald eagles is guided by the *Bald Eagle Site Management Plan for the Hanford Site, South-Central Washington* (Fitzner and Weiss 1994) and coordinated with representatives of the U.S. Fish and Wildlife Service.

The Hanford Reach is expected to continue providing wintering habitat as long as critical resources such as food, perches, and relative freedom from human activities are maintained. Limited nest building by bald eagles has been observed at the Hanford Site in recent years. The presence of a bald eagle pair attending a nest site along the Hanford Reach near White Bluffs triggered the closure of roads and a small portion of the Hanford shoreline during late winter and early spring 1996. The eagles eventually left the area without successfully nesting.

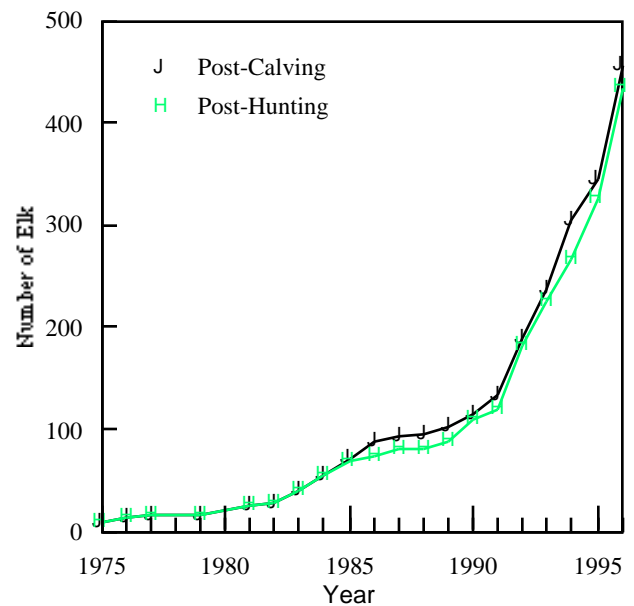
## Hawks

The undeveloped land of the semiarid areas of the Hanford Site provides nest sites and food for three species of migratory buteo hawks: Swainson's, red-tailed, and ferruginous. Under natural conditions, these hawks nest in trees, on cliffs, or on the ground. Power-line towers and poles also can serve as nest sites, and these structures are well used by nesting hawks on the Hanford Site because of the relative scarcity of trees and cliffs. The ferruginous hawk is a U.S. Fish and Wildlife Service candidate species for listing as threatened and/or endangered (50 CFR 17.11). In recent years, the number of ferruginous hawks nesting on the Hanford Site has increased. The site continues to provide hawk nesting habitats that are administratively protected from human intrusion. An evaluation of selected aspects of ferruginous hawk ecology on the Hanford Site and adjacent lands was completed as part of a Master of Science degree in raptor biology (Leary 1996). That work suggests that ferruginous hawks nesting on the Hanford Site are attracted to the area because of suitable nesting habitat, but that much of the foraging for prey species is conducted in privately owned agricultural fields located several kilometers (miles) from the nest sites. Thus, male ferruginous hawks were observed to travel up to 15 km (9.3 mi) from their Hanford nest sites to hunt, making several trips each day to deliver prey to their mates and offspring. Leary's results showed that medium-sized mammals such as northern pocket gophers, which can be serious agricultural pests, are the primary prey of ferruginous hawks. Thus, we have gained a new appreciation of how the ecology of this large raptor takes on a regional perspective and does not recognize land ownership boundaries. It is likely that the success and relative abundance of ferruginous hawks nesting at Hanford depend on both Hanford lands for quality nesting habitat and adjacent private agricultural lands for suitable foraging habitat.

## Rocky Mountain Elk

Rocky Mountain elk did not inhabit the Hanford Site when it was established in 1943. Elk appeared on the Fitzner/Eberhardt Arid Lands Ecology Reserve in the winter of 1972. A few animals stayed and reproduced. Since that time, the herd has grown and it now occupies portions of the Hanford Site, the United States Army's Yakima Training Center, and private land along Rattlesnake Ridge. Herd size was estimated from census data

at approximately 450 animals prior to the 1996 hunting season (Figure 6.2.3). Although accurate estimates of elk harvest on adjacent private lands are not available, the harvest appears to be small, with less than 10% of the herd being harvested and the majority of the harvest consisting of bulls. Thus, growth of the herd is largely unconstrained, and increasing damage to natural plant communities on Hanford and to crops on adjacent private land is likely. Several observations were made in 1996 of elk having crossed to the north side of State Highway 240, making future sitings of elk near the 100 and 200 Areas probable.



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**Figure 6.2.3.** Elk on the Hanford Site Counted by Aerial Surveillance During the Post-Calving (August through September) and Post-Hunting Periods (December through January), 1975 Through 1996

## Mule Deer

Mule deer are a common resident of the Hanford Site and are important because of the recreational (offsite hunting) and aesthetic values they provide. Because mule deer have been protected from hunting on the Hanford Site for approximately 50 years, the herd has developed a number of unique population characteristics different from most other herds in the semiarid region of the Northwest. These characteristics include a large proportion of old-age animals (older than 5 years) and large-antlered

males. This herd provides a unique opportunity for comparison to other more heavily harvested herds in this region.

Because of the unique nature of the herd and high degree of public interest, and because observations were made that some male deer had abnormal antler development, studies were initiated in the early 1990s to 1) obtain estimates of the number of deer on the Hanford Site, 2) determine the extent and frequency of offsite movements by Hanford Site deer, 3) evaluate the level of strontium-90 in deer from the 100 Areas, and 4) evaluate the occurrence of abnormal antler development in male deer. A report detailing the results of the strontium-90 in deer was published in 1995 (Tiller et al. 1995), and the remaining work was recently reported (Tiller et al. 1997) and is highlighted below.

The deer population onsite was estimated by marking several Hanford deer and counting the ratio of marked to unmarked animals along the Columbia River. In addition, relative deer densities were determined throughout the remainder of the Hanford Site by comparing the frequency of fecal pellet groups found within each region. Approximately 330 deer were estimated to reside in the region of the Hanford Site bordering the Columbia River, and the total Hanford Site mule deer population, exclusive of the lands lying north of the Columbia River, was estimated at 650.

A total of 25 deer (5 in 1993 and 20 in 1994) have been examined for testicular atrophy and abnormal antler development. All affected animals (12) were more than 4 years old; 10 were between 8 and 12 years old. The unaffected animals were between 1 and 6 years old. Blood tests revealed no parasitic cause for the testicular atrophy, and radiation was ruled out because radionuclide levels in tissues were low and there were no effects found in other tissues. Testicular atrophy and abnormal antler development have been reported in mule deer from other areas in the United States, including Arizona, California, Texas, and Colorado. Analysis of the radiocollared normal and affected animals' movement on the site suggests that the two groups readily intermix; however, affected animals are common only along the Columbia River portions of the site. Seasonal foraging patterns suggest that woody plants (principally bitterbrush and riverine shrubs such as mulberry, willow, and Russian olive) comprise a large portion of their diets. Several plants known to produce estrogen-like compounds also were found in deer diets during the summer and may influence their reproductive performance.

## Establishment/Sampling of Permanent Monitoring Plots

Methods for monitoring the fauna and flora at Hanford are currently undergoing review with the goal to improve the measurement of natural and human-caused change and to evaluate ecosystem health. Management goals for both inventory and monitoring were identified in *Hanford Site Biological Resources Management Plan* (DOE 1996f). As an initial step in the process of improved biological resource monitoring, 30 permanent plots were established in selected habitat types across the site to collect baseline information. Plot locations were determined based on the condition of the site, the sensitivity of the habitat type to land use change, and the amount of prior information available for the sampling area. Vegetation surveys were conducted on these 20-ha (49.4-acre) plots during the spring and summer months of 1996 to provide biodiversity and monitoring information on the plant communities found on the Hanford Site. Obtaining baseline information on vegetation associations onsite is especially relevant to resource monitoring because plant communities function as integrators of physical environment. The soils, climate, topography, and history of a land area determine the type and extent of vegetation that have developed on the site. Important vegetation parameters measured on the plots include the canopy cover by species and the number of species found there.

Canopy cover is a measure of the percentage of the ground area that lies beneath the plant canopy (the extent of the foliage) (Table 6.2.1) and provides information on the dominant plant species in the community, species associations, and amount of habitat available for wildlife. In shrub-steppe plant communities, there can be several different layers in the canopy, and the total canopy cover may be greater than 100%. For example, grasses and forbs often grow beneath and intermix with shrubs, and the total percent canopy cover is a sum for each species in each canopy layer in the area sampled. Along with the vascular plants sampled along transects in each plot, the percentage of the ground covered with "biotic crust" (i.e., lichens, mosses, and algae that grow and form a crust on the soil surface) was also estimated. Biotic crusts play important roles in fixing nitrogen and stabilizing soils in semiarid and arid ecosystems. The mean values of total percent canopy cover calculated for each plot are listed in Table 6.2.1 as well as the canopy cover of native versus alien plant species. Alien plant species are those that have been introduced into this ecosystem from other parts of the country or other continents. Prominent examples

**Table 6.2.1.** Summary of Mean Canopy Cover and Species Abundance for 30 Permanent Monitoring Plots Established in 1996

Plot	Mean Percent Canopy Cover				Number of Species		
	Total	Alien	Native	Biotic Crust	Total	Alien	Native
1	46.5	32.2	14.3	28.2	32	8	24
2	74.6	55.3	19.3	3.6	36	7	29
3	62.6	42.4	20.2	14.1	37	8	29
4	56.5	45.1	11.5	20.2	34	8	26
5	56.4	28.6	27.8	24.8	45	7	38
6	48.8	23.2	25.7	17.8	37	7	30
7	86.6	32.3	54.4	37.1	34	9	25
8	67.1	6	61.1	70	35	8	27
9	64	37.1	26.9	19	35	10	25
10	67.2	35.6	31	24.4	48	7	41
11	43	14.4	28.6	27	44	8	36
12	86.6	11.7	74.8	56.8	62	8	54
13	91.6	19.3	72.3	42.8	55	9	46
14	62.9	45	17.8	17.7	36	8	28
15	60.2	37.5	22.8	23.2	36	7	29
16	54.5	22.3	32.2	21.2	39	7	32
17	81.6	44.5	37.1	37.8	48	10	38
18	59.5	20.2	39.3	40.6	22	3	19
19	70.9	55.9	14.9	28.5	26	7	19
20	70.2	36.8	33.4	35.2	46	8	38
21	78.6	58.6	20	50.3	29	9	20
22	61.5	13.3	48.3	38.3	34	5	29
23	81.8	40.9	40.9	48.8	36	9	27
24	71.7	2.9	68.7	59.8	47	9	36
25	69.6	23.5	46.2	40	41	8	33
26	60.7	10.8	49.9	48.7	35	6	29
27	54.3	31.9	22.4	29.7	42	9	33
28	75.1	23.6	51.5	48.6	46	8	38
29	67.6	24.9	42.8	42.2	32	3	29
30	91.1	37.4	53.7	41.7	50	9	41

of alien plant species on the Hanford Site include Russian thistle (*Salsola kali*), cheatgrass (*Bromus tectorum*), and knapweeds (*Centaurea* spp.). The presence, increase, or dominance of alien plant species within a community can be indicative of disturbance to that community.

The total plant canopy cover found on the 30 plots across the site ranged from 56% to 92%, with alien species canopy cover ranging from 3% (4.2% of total canopy cover) to 58% (75% of total canopy cover). Estimates of

the amount of biotic crust cover ranged from 3% to 60%; total cover (vascular plant cover and biotic crust cover ranged from 66% to 143%.

Another important measure is the species richness of the plant community, which can be expressed most simply by the total number of plant species that occur in the plot. Table 6.2.1 gives species richness numbers based on all plant species found on the 20-ha (49.4-acre) plots and summarizes this information for alien and native

species. Plots with the greatest numbers of species were located at elevations above 610 m (2,000 ft) on the Fitzner/Eberhardt Arid Lands Ecology Reserve. High species diversity was also found on plots occurring in 1) sand dune areas on the Columbia Plateau, 2) lithosols, and 3) areas with mature shrub overstory. Plots in areas that have been impacted by wildfires, in general, had slightly fewer species.

The information obtained from the plot sampling will be used to assess impacts from both human activities, to evaluate ecosystem health, and to provide technical data useful for Hanford Site land use planning.